ผลของการตั้งค่าเครื่องกะเทาะแบบลูกยางต่อปริมาณการแตกหักของข้าวกล้องและปริมาณข้าวเปลือกที่ไม่ถูกกะเทาะสำหรับเครื่องกะเทาะระดับห้องปฏิบัติการ

The effects of rubber roll huller setting on quantities of brown rice kernel breakage and un-husked paddy for laboratory hulling.

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Abstract

The purpose of this study was to investigate the effects of the clearance between rubber roll huller and feed rate on laboratory hulling for getting the maximum head brown rice yield. The long grain paddy (*Oryza sativa*) of Khaw Dawk Mali 105 variety was used for this study and demonstrated by quantity of head brown rice yield, broken brown rice and un-husked paddy. The experimental implied the appropriate clearance of rubber roll huller setting is 0.6 to 0.8 mm, an optimum feed rate is 200 to 300 g/min. The setting followed this condition was found to be the maximum percentage of head brown rice, less percentage of broken brown rice and the minimum percentage of un-husked paddy.

Keywords: Paddy, Hulling setting, Milling quality. hulling quality results showed in term of

บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อทำการทดสอบผลของการตั้งระยะห่างระหว่างลูกยางกะเทาะและอัตราการป้อนข้าวเปลือกของเครื่องกะเทาะในระดับห้องปฏิบัติการเพื่อให้ได้ข้าวกล้องเต็มเมล็ดสูงสุด โดยผลการทดสอบกะเทาะข้าวเปลือกพันธุ์ขาวดอกมะลิ 105 ซึ่งแสดงในรูปของปริมาณต้นข้าวกล้อง ข้าวกล้องหัก และข้าวเปลือกที่ไม่ถูกกะเทาะ พบว่าระยะห่างระหว่างลูกยางกะเทาะที่เหมาะสมอยู่ระหว่าง 0.6 – 0. 8 มิลลิเมตร ที่อัตราการป้อน 200 – 300 กรัมต่อนาที เงื่อนไขการปรับตั้งนี้พบว่าทำให้ได้ต้นข้าวกล้องอยู่ในเกณฑ์สูงและเหลือปริมาณข้าวเปลือกที่ไม่ถูกกะเทาะอยู่เพียงเล็กน้อย

คำสำคัญ: ข้าวเปลือก การปรับตั้งเครื่องกะเทาะ คุณภาพการสีข้าว

Introduction

Rice (*Oryza sativa* L) constitutes the world's principal source of food, being the basic grain for the planet's largest population. For tropical Asians it is the staple food and is the major source of dietary energy and protein. In Southeast Asia alone, rice is the staple food for 80 % of the population (Armienta, 1991)

Milling of paddy is usually done at moisture content about 11 % to 14 % wet basis. From the economic point of view, Rice breakage during milling causes a significant economic loss since broken rice often has 1/2 to 1/3 the value of whole milled rice. Hence, it is critical from an economic standpoint to maintain HRY as high as possible because the quality of milled rice is mainly in terms of percent head rice yield. (Lu and Siebenmorgen, 1995)

In this present, milling quality denotes to be criteria for price of rice market especially percent of HRY. Various laboratories mills are usually use in rice market and research works. Laboratory mill is simulating production conditions have been proposed to measure the milling quality of paddy. The McGill system is used in the United Stages. Satake units are popular because they allow dehulling and milling of smaller batches of samples (Juliano, 1994). Most of the dehusker or hulling step of research work in Thailand, laboratory model rubber roll sheller of Satake (THU-35, Satake, Hiroshima, Japan) have been used. But for Thai rice market, has

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often used Thai House-band rubber roll hulling.

In Thailand, the standard of hulling testing is followed by the method of The Ministry of Agriculture and Cooperatives and also referred on operation procedure of Satake Corporation, Japan. The details are general operation setting and procedures. For example, adjusting range of clearance between roller setting (0.5 to 1.2 mm), paddy's feed rate (not exceed than 300 g/min). But in general, effect of machine setting and human error from feeding can be increase the percentage of broken rice and un-husked paddy. Effected to percentage of optimum HRY and complicated many of un-husked paddy with separating out from brown rice and hulling again by hand. The optimum clearance setting for Thai's paddy was reported by Jirapong (2001). The result shown clearance is 0.5 to 0.85 mm. However, there is a dearth of information on laboratory hulling setting and the error of human operation especially feeding rate for Thai's paddy wasn't had report. Therefore, this study was conducted to experimentally investigate the effects of clearance between rubber roll huller and feed rate of laboratory hulling on hulling qualities of paddy.

MATERIALS AND METHODS

Long grain samples of the Khao Dawk Mali 105 variety (KDML105) which was cultivated in December 2004 from Kalasin Province, Thailand was used for this experiment. The paddy crop was cultivated in December 2004 at Kalasin Province, Thailand. After harvesting, it was dried with ambient air dryer, then cleaned and removed foreign materials.

The fissured and cracked kernel grain number per 100 grains was determined with five replications. The physical grain quality; dimensions, length *l*, breadth *b*, and thickness *t* ; were measured in mm at 1000 grain samples. The equivalent diameter D in mm considering a prelate spheroid shape for rice grain was calculated following expression (Mohsenin, 1970):

$$D = \left[4l\left(\frac{b+t}{4}\right)^2 \right]^{\frac{1}{3}}$$

Three experimental apparatus are huller, belt feeder and rice grader as shown in figure 1. The huller was rubber roll type (Satake Engineering Laboratory Model Type THU-35). The feeder was belt conveyor type using paddy container for feeding. The head rice was separated from broken kernels using a rice grader (Satake Test Rice Grader Type TRG). In this experiment, A two-factors of this testing was the clearance between rubber roll huller and feed rate. Set up with five levels of their clearance between rubber roll huller, that is 0.4 mm, 0.6 mm, 0.8 mm, 1.0 mm and 1.2 mm were used during the test. The feed rates for each clearance between rubber roll huller were used 200, 250, 300, 350 and 400 g/min. The experiment was replicated three times. In each hulling test, paddy sample was filled in paddy container on belt conveyor and free flow into the hopper of huller machine, so it was passed twice though huller which was set with different clearance setting for test. After that, un-husked paddy was separated by hand out off brown rice sample. Next, the HRY was separated from broken kernels by using a rice grader.

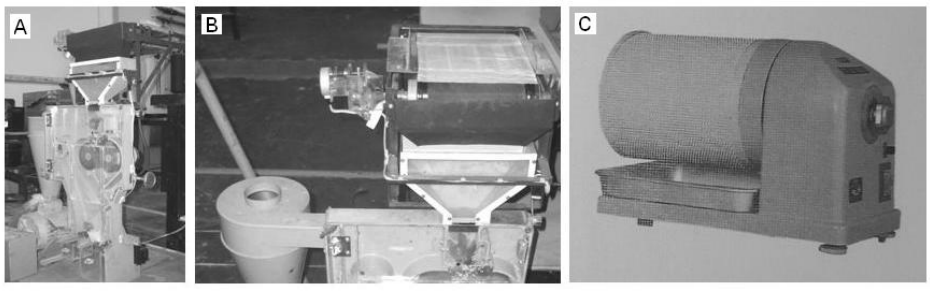

Figure 1 Experimental apparatus, huller (A), belt feeder (B) and rice grader (C).

Percentages head brown rice; broken brown rice and un-husked paddy were calculated on the basis of

initial weight of paddy sample as follow:

$$\text{Percentage of head rice yield} = \frac{\text{Weight produced head brown rice}}{\text{Weight processed paddy}} \times 100\ \%$$

$$\text{Percentage of broken brown rice} = \frac{\text{Weight produced broken brown rice}}{\text{Weight processed paddy}} \times 100\ \%$$

$$\text{Percentage of un-husked paddy} = \frac{\text{Weight of un-husked paddy}}{\text{Weight processed paddy}} \times 100\ \%$$

RESULTS AND DISCUSSION

The average axial dimensions and equivalent diameter for raw paddy are shown as follow. Average, length *l*, breadth *b*, and thickness *t*, were 10.29, 2.56 and 2.03 mm, respectively. The equivalent diameter *D* was 3.78 mm.

Hulling qualities are summarized on average percentage term, showed in table 1 and effects of factors related to hulling quality are presented in figure 2. Analysis of variance (ANOVA) showed that a significant effect of clearance between rubber roll huller and feed rate on hulling qualities at $P < 0.05$.

Table 1 Effect of clearance between rubber roll huller an feed rate on average percentage of hulling qualities

Hulling Quality	Clearance between rubber roll huller	Feed rate (g/min)				
		200	250	300	350	400
Head brown rice	0.4	70.59^{a}_{C}	70.76^{a}_{BC}	71.13^{a}_{ABC}	71.58^{a}_{A}	71.37^{a}_{AB}
	0.6	70.53^{a}_{C}	71.28^{a}_{AB}	70.73^{a}_{BC}	71.24^{a}_{ABC}	71.45^{a}_{A}
	0.8	70.86^{a}_{C}	70.69^{a}_{D}	71.04^{a}_{B}	71.13^{a}_{B}	71.34^{a}_{A}
	1.0	70.46^{a}_{AB}	70.43^{a}_{AB}	70.16^{a}_{B}	70.44^{a}_{AB}	70.72^{b}_{A}
	1.2	69.62^{b}_{A}	67.69^{b}_{B}	66.48^{b}_{B}	58.13^{b}_{C}	58.96^{c}_{C}
Broken	0.4	5.70^{a}_{A}	5.52^{a}_{AB}	5.11^{b}_{BC}	4.86^{a}_{C}	5.04^{a}_{BC}
Brown Rice	0.6	5.82^{a}_{A}	5.11^{a}_{A}	5.66^{a}_{A}	5.23^{a}_{A}	5.01^{a}_{B}
	0.8	5.39^{a}_{A}	5.46^{a}_{A}	5.11^{b}_{B}	5.08^{a}_{B}	4.82^{a}_{C}
	1.0	4.99^{b}_{A}	5.05^{a}_{A}	4.62^{c}_{BC}	4.09^{b}_{D}	4.58^{b}_{C}
	1.2	4.37^{b}_{A}	3.13^{b}_{B}	3.74^{d}_{AB}	3.14^{c}_{B}	3.31^{c}_{B}
Un-husked	0.4	0.11^{d}_{B}	0.11^{b}_{B}	0.19^{c}_{A}	0.16^{c}_{AB}	0.16^{d}_{AB}
paddy	0.6	0.10^{d}_{A}	0.17^{b}_{A}	0.16^{c}_{A}	0.14^{c}_{A}	0.15^{d}_{A}
	0.8	0.29^{c}_{C}	0.38^{b}_{BC}	0.44^{c}_{ABC}	0.47^{c}_{AB}	0.55^{c}_{A}
	1.0	1.48^{b}_{CD}	1.40^{b}_{D}	2.37^{b}_{B}	2.68^{b}_{A}	1.70^{b}_{C}
	1.2	3.24^{a}_{C}	7.66^{a}_{B}	8.32^{a}_{B}	19.87^{a}_{A}	18.63^{a}_{A}

a-d Data within a column followed by same superscript letters are not significantly differently at P<0.05.
A-E Data within a row followed by same superscript letters are not significantly differently at P<0.05.

Least significant difference (LSD) was used to evaluate mean values of the effect of clearance between rubber roll huller and feed rate setting. Comparison between treatment means were showed no significant differences for head brown rice yield at clearance 0.4, 0.6, 0.8 and 1.0 mm at all feed rate. Broken brown rice was increased at low clearance between rubber roll, the highest value was found at 0.4 mm clearance level. Minority of broken kernels, about 3% was raised at clearance 1.2 mm at all feed rate. However, Un-husked paddy was rapid-rate increasing at clearance 1.0 mm and 1.2 mm. From figure 2, it confirmed that Un-husked paddy was increase if clearance highly than 0.8 mm at all feed rate, and HRY was dropped at high feed rate, 350 g/min and 400 g/min.

The experimentation showed the optimum clearance between rubber roll adjusting similar to Jirapong

report in 2001. In addition, an appropriate feed rate setting also same as operation procedure of Satake Corporation, Japan.

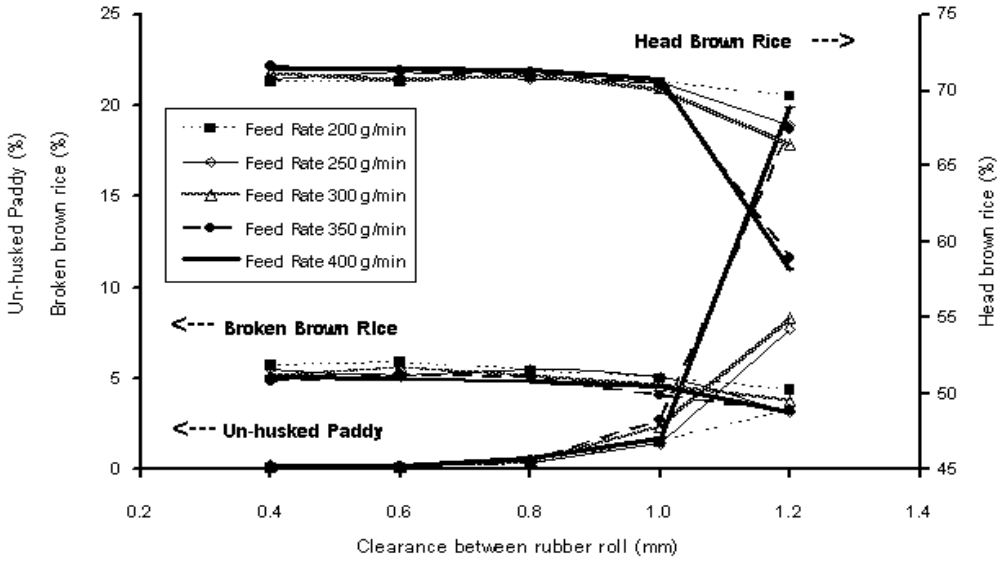

Figure 2 Effects of clearance between rubber roll hullers and hulling qualities at different feed rates

CONCLUSIONS

The clearance between rubber roll huller and feed rate affected the hulling quality, head rice yield, broken brown rice and un-husked paddy. These results showed an optimum clearance between rubber roll huller are 0.6 to 0.8 mm on feed rate 200 to 300 g/min., giving less amount of un-husked paddy and low percentage of broken rice. In opposite, the result showed an increasing of un-husked percentage when set up the clearance more than 1.0 mm, especially clearance 1.2 mm on every feed rate It was found that the rapid-rate of un-husked increasing from 3.24 to 19.87 %. Although the result of clearance setting at 0.4 mm showed high percentage of HRY and also low percentage of un-husked, the percentage of broken rice was higher than every treatments too

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